IR-3 Information System for Global Environmental Outlook

Contact Person: Kuninori Otsubo
Deputy Director
Water and Soil Environmental Division
National Institute for Environmental Studies
16-2 Onogawa, Tsukuba, Ibaraki 305, JAPAN
Tel: +81-298-50-2417 Fax: +81-298-50-2576
Email: kuninori@nies.go.jp

Total Budget for FY1995-FY1997: 80,422,000 (FY1997: 28,658,000) Yen

Abstract:

This research project aimed to design information system which enables to grasp the state of global environmental problems and to measure effects of responding policy options quantitatively. With reference to earlier and on-going projects on sustainable development, we proposed a framework of the information system, then applied the framework to our case studies on sustainable agriculture, sustainable use of water resources and sustainable forest, and identified key indicators for each case.

The information system formulated through this project is a kind of protocol to inter-link the concept of sustainable development with indicators. The system may be useful for facilitating mutual understanding of environmental problems and sustainable development between developed and developing countries. The system was designed to be understandable for the public as well as decision-makers. The proposed system has a hierarchy framework, and, in the framework, selected indicators are classified by Criteria and the D-S-R (Driving Force - State - Response) concept. This information system may help decision makers conduct appropriate environmental policies on global environmental problems.

Data at national level were collected for many countries including the European and Africa region. Those data were used for trial-error investigation to select indicators. Useful data have been collected into a chronological database system. On the other hand, lack of data was clarified. Through the above case studies, it was recognised that further efforts of data collection was necessary through existing regional networks such as TEACOM (Temperate East Asia Regional Committee for START), SASCOM (South Asia Regional Committee for START) and SARCS (Southeast Asia Regional Committee for START).

The case studies conducted in this project were limited in the above three fields, therefore, key indicators do not cover overall fields in relation to sustainable development at national level. It is necessary to apply the information system to another fields for this purpose.

Key Words: Environmental Information system, Database, Environmental Indicator, Global Environmental Outlook

1. Introduction

Rapid economic and population growth are expected in the Asia and Pacific region as a drastic growth point of the world. As globalisation of environmental problems is getting obvious, accurate policy responses are required based on appropriate evaluation of

environmental problems are required.

As Agenda 21, adopted at UNCED in 1992, noted that it is necessary to grasp interrelation between nature and human activities. It also noted the necessity of construction of information system or indicators that are useful for decision-makers. Influenced by the concept, various international organisations such as UNEP (United Nations Environmental Programmes), CSD (Committee for Sustainable Development) and OECD (Organisation for Economic Co-operation and Development) etc. have been developing an information system and indicators for sustainable development.

The target of those projects is to select representative indicators rather than index. The important issues in the projects are to select key issues in environmental problems and to closely connect selected representative indicators with environmental policy. Those projects have played important roles in selecting indicators and developing information system and so far have developed diverse indicators.

However, most of the indicators that developed by those projects have not been systemised to clarify the concept of sustainable development. The problems of the existing indicators are also pointed out as follows:

- Useful indicators are a few because of data limitation.
- Select indicators are not linked with the concept of sustainable development and data.
- Indicators are not helpful for evaluating the state of the environment in the Asia and Pacific region.

Considering the above problems of the existing indicators, a desirable environmental information system and indicators have been developed.

2. Research Objective

This research project had the following goals:

- to design information system in order to grasp the state of global environmental problems and to measure effects of responding policy options quantitatively.
- to select key indicators to evaluate sustainability, focusing on the Asia and Pacific region.
- to clarify data availability
- to establish a chronological database system linked with indicators.

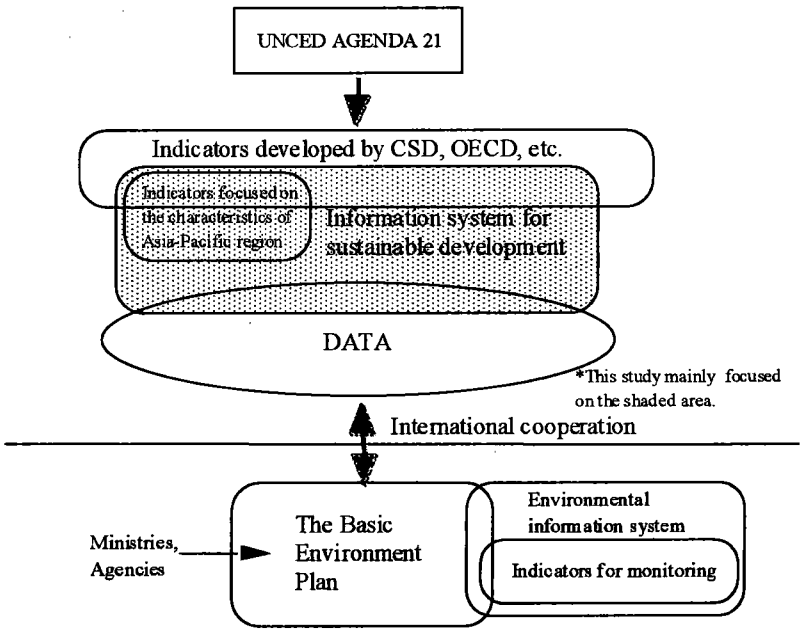

Figure 1 Relationship between this project and international activities developing indicators for sustainable development

3. Research Results

(1) Environmental information system

Based on reviews of the above international research projects, problems and issues of the indicators developed by the above international organisations were clarified. In order to construct an environmental information system that provides useful information with decision-makers, a peculiar framework of information system and its structuring method were developed. The characteristics of a desirable information system formulated through this project are as follows:

- clarify the concept of sustainability,
- select key factors to measure sustainability, and
- secure transparency of the environmental information system

1) Framework of the information system

The information system has a hierarchy framework which consists the four levels: Level 1 Concept of sustainability, Level 2 Criteria, Level 3 Indicators, and Level 4 Data (Figure 2). Selected indicators are also classified by D-S-R framework. The concept, sub-concepts, indicators and data are inter-linked systematically, and therefore which enable users to understand key issues of sustainable development and to clarify the relationships between the concept and indicators. The system has a merit of being understandable for users.

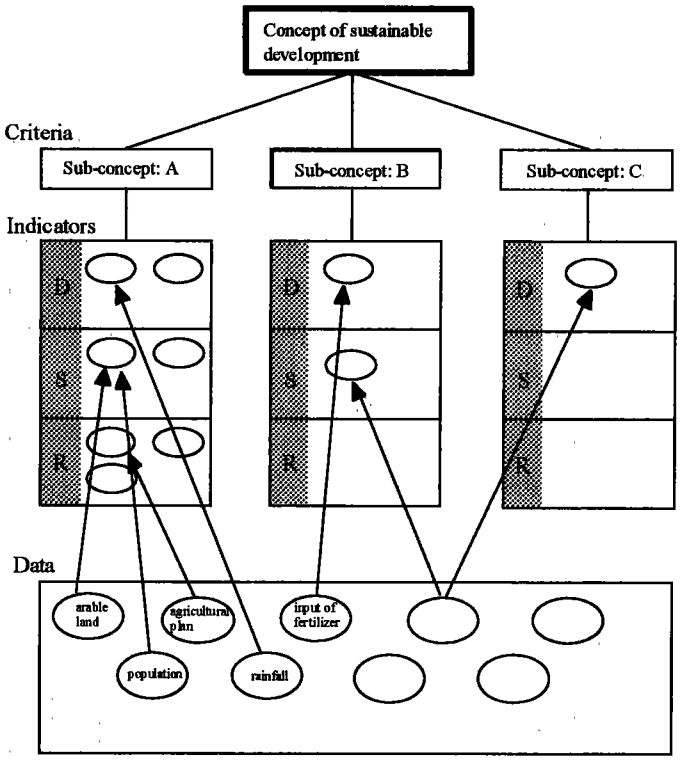

Figure2 Framework of information system

2) 3-dimensional graph

One of the most important issues of this project was to make clarify the concept of sustainable development in relation to various fields. However, according to levels of space, the inter-relation between human activities and the environment are diverse. It was very difficult to select sub-concepts to break down the concept of sustainability by an uniformed way. As Figure 3 shows, in order to make clear such complicated relationships, this project established a method of 3 dimensional graph that consists of three axes: X-axis (human activities), Y-axis (resources) and Z-axis (space). The inter-relation between human activities and resources regarding agriculture, water resource and forest are shown differently. The factors on the both axes are criteria that should be considered

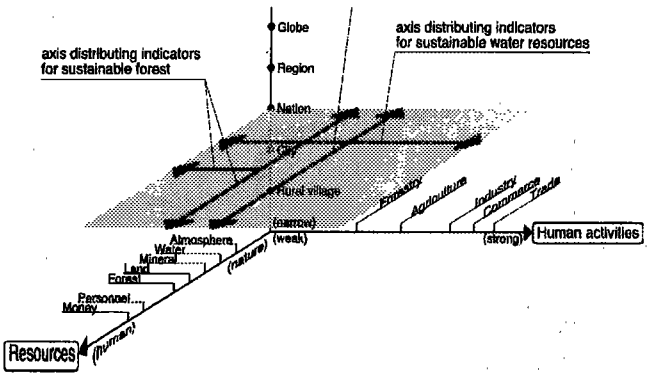

Figure3 3-dimensional graph

in each field, and the intersecting points between X and Y-axis show indicators.

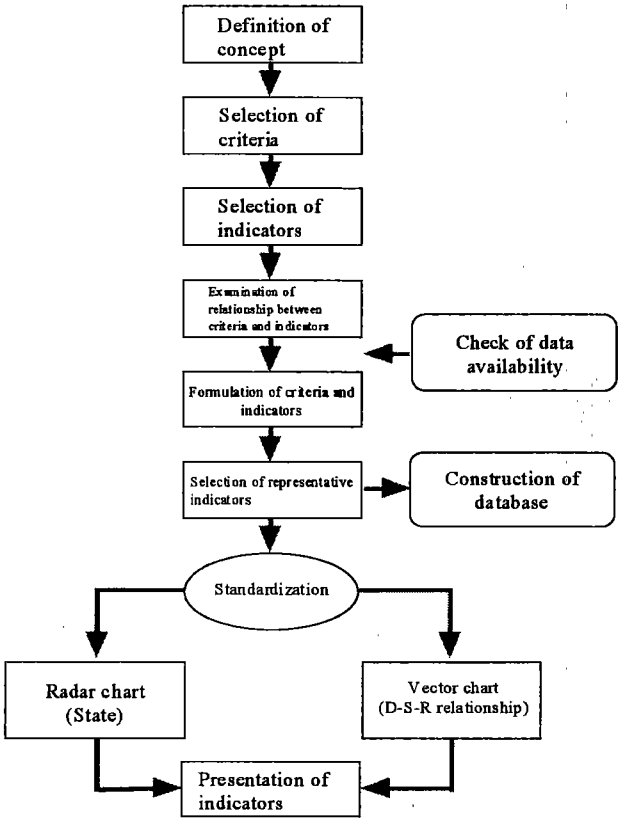

Figure 4 Procedure of structuring an information system

3) Methods of securing clarification – Presentation methods of indicators

So far, various methods indicating the concept of sustainable development have been developed. With reference to the existing methods, the project developed two presentation methods that were easily understandable for both decision-makers and the public. One is vector chart that shows the trend of indicators by countries. The other is radar chart that is useful for comparative analysis of sustainability.

(2) Procedure of structuring an information system

Various specialists were involved in this project, and discussed how to construct a desirable framework of information system and to select and develop indicators. As a result, the project established a process to structure the information system, as Figure 4 shows.

(3) Case studies

Case studies on agriculture, water resources and forest were carried out to construct information systems of those fields. According to the established methods and information system, key indicators of each field were examined and selected by trial and error investigation using charts (Figure 4, 8, 9 and 10 etc). On the other hand, data availability was investigated. As a result, data, especially in terms of environmental load, were poor. In the meanwhile, as most of the data and information on policy response were qualitative, a few useful indicators were selected.

Therefore, it is necessary to collect data to develop indicators and limited data, through the existing regional networks such as TEACOM (Temperate East Asia Regional Committee), SASCOM (South Asia Regional Committee) and SARCS (Southeast Asia Regional Committee for Start) that consist of Asian countries.

1) The concept and criteria of sustainable development in relation to agriculture

The related resources and functions of agricultural activities were examined to clarify the concept of sustainable agriculture (see Figure 5). The concept was broken down and categorised into the below 7 criteria.

Criterion 1: indicates quantity of arable land resources,
Criterion 2: indicates appropriateness of arable land management,
Criterion 3: indicates soundness capital and personnel inputs on agricultural activities,
Criterion 4: indicates environmental load of agriculture,

Criterion 5: indicates contribution to self-sufficiency of cereals,
Criterion 6: indicates functions of land and environmental conservation, and
Criterion 7: indicates appropriateness of allocation of national resource.

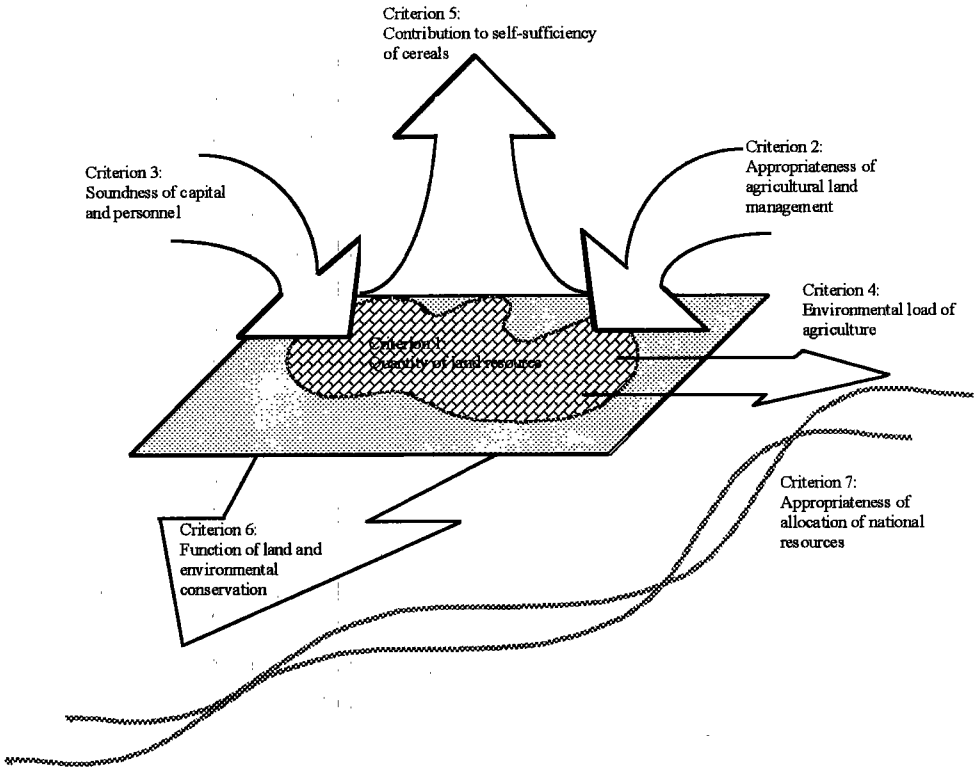

Figure 5 Concept of sustainable development on agricultural activities

2) Vector chart

Vector chart is shown by 2-dimesional graphs (Figure 6-11). X-axis means 'driving force' and Y-axis means 'state'. Data were plotted and shown by vectors (Figure 6-10). The chart clarified the relation between driving force and state. Representative indicators were selected by trial-error investigation. From Graph 6-10, with economic development, it is estimated that developing countries of the Asia and Pacific region were/are tracing the same path of the developed countries.

The countries in the Asia and Pacific region were increased crop production along with the increase of fertiliser input (Figure 6). Agricultural population was decreased with the economic growth (Figure 7). According to those Figures, it is estimated that Japan has been developed agricultural activities. On the other side, it met various environmental problems similarly to the European countries. In addition, as Figure 8 and 9 show, food styles of the developing countries including the Asian countries have been changing from crop to meat.

Vectors charts were also used for structuring a model to simulate food production and food shortage in the Asia and Pacific region by 2020. Figure 10 shows the projection of future food shortage of 15 countries in the region. Serious food shortage is expected in the Asian region.

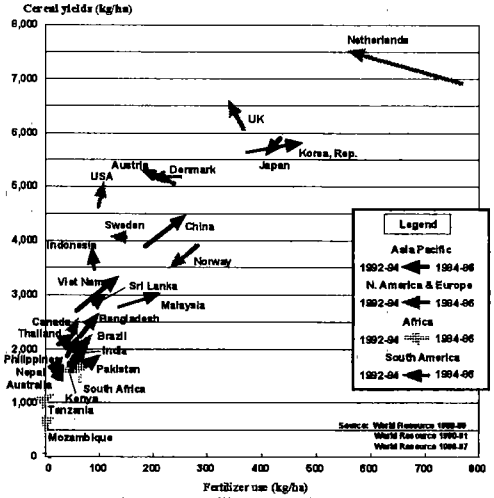

Figure 6 Fertilizer use and cereal yields

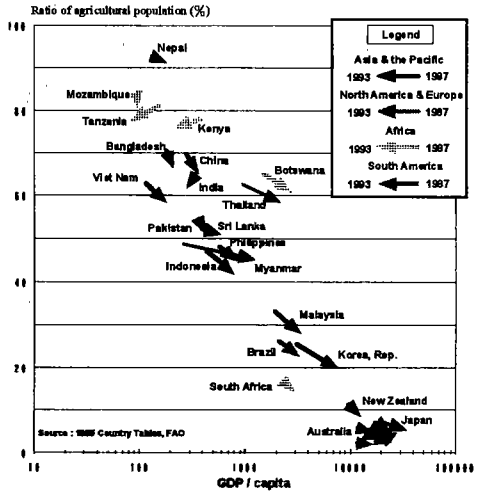

Figure 7 Agricultural population and economic development

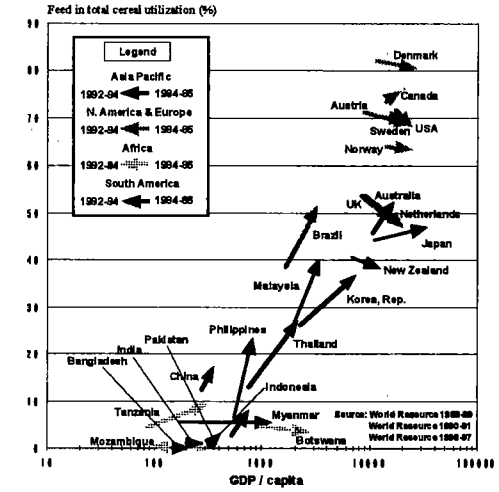

Figure 8 Feed in total cereal utilization and economic development

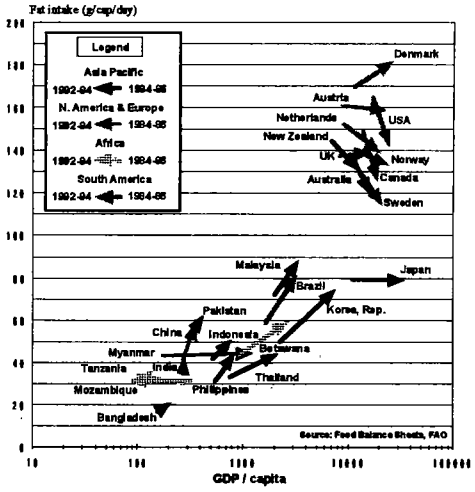

Figure 9 Change of fat intake

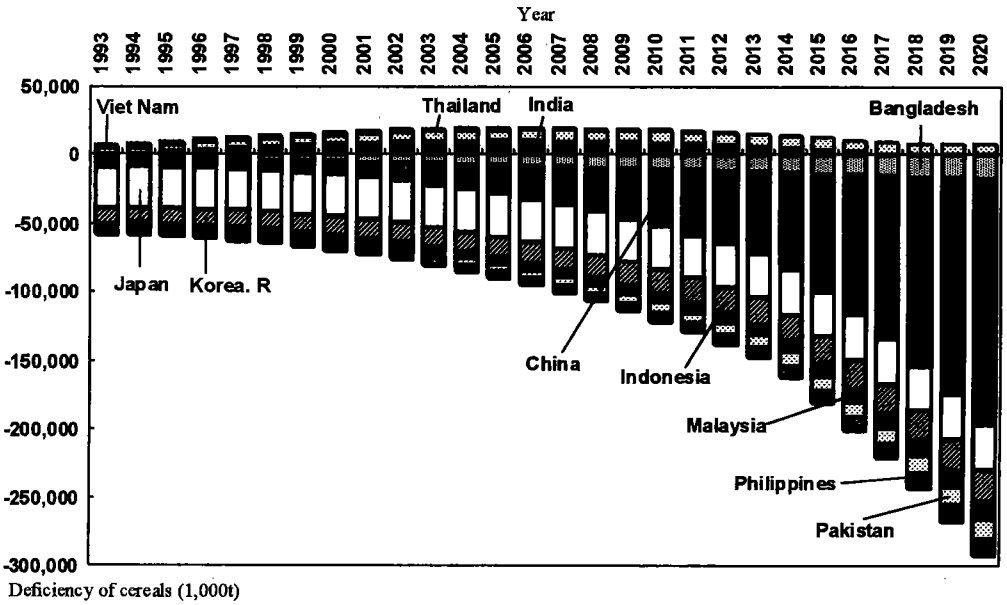

Figure 10 Projection of the deficiency of cereals in 15 Asian countries

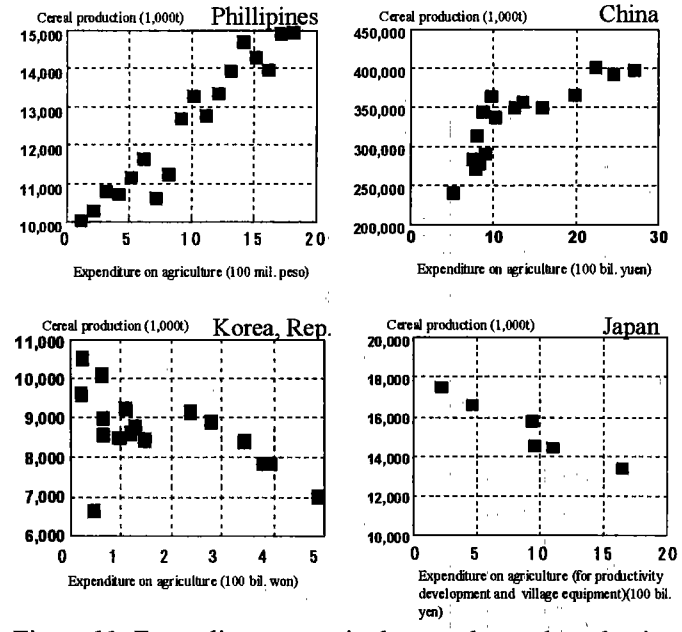

Figure 11 Expenditure on agriculture and cereal production

3) Budgetary distortion (Criterion 7)

Indicators regarding Criterion 7 was developed to evaluate distortion of budgetary distribution of governments to industries. In four countries: Philippines, China, Korea Rep, and Japan, data regarding agricultural investment and crop production was available. Using graph, the relationships between them were investigated. As Figure 11 shows, the crop production in Philippines and China was increased in proportion to the increase of their investments. While, in Korea Rep. and Japan, inversely proportional relationship between the factors was recognised. Considering the difference, it could be guessed that investments are not used for agricultural production. This suggests that Criterion 7 needs to be considered linked with Criterion 3 and 6.

4) Radar chart

Radar charts are useful for comparative analysis of the state of the environment. The selected indicators on agricultural activities were integrated and normalised by 7 criteria as below, and radar charts of 50 countries were produced (Figure 12).

Criterion 1: arable and permanent pasture per total land area (%),
Criterion 2: annual averaged crop production (kg/ha),
Criterion 3: decrease rate of agricultural population,
Criterion 4: environmental load caused by agricultural activities,
Criterion 5: self-sufficiency (%),
Criterion 6: ratio between arable land and cultivated area being weighted by functions of land and environmental conservation.

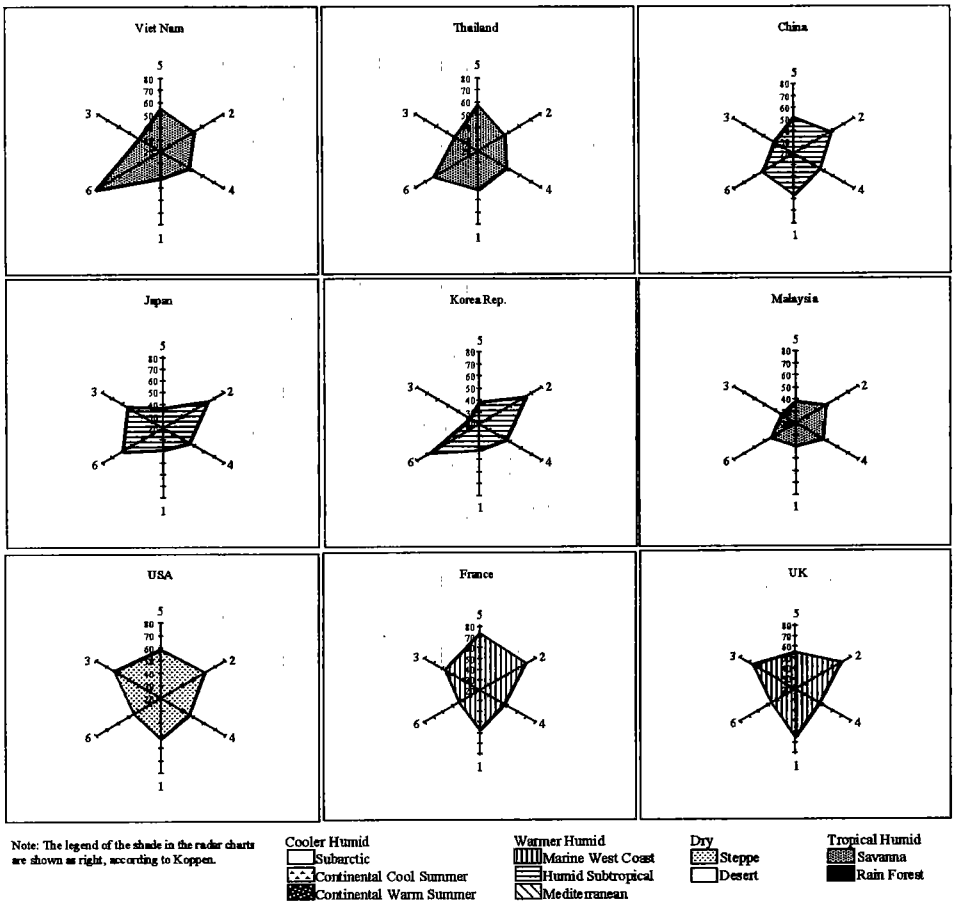

Figure 12 Radar chart

4. Discussion

(1) Evaluation of this project

The project established a framework of a desirable information system that interlinks between the concept and indicators of sustainable development. Application to the information system in the fields of agriculture, water resource and forest was carried out. Through the case studies, the project established information systems and selected key indicators. In addition, the data availability of selected indicators was also verified. Useful data were collected into a chronological database system.

Integrated and qualified information by classified by D-S-R and hierarchy frameworks is understandable for decision-makers and is helpful for them to conduct appropriate environmental policy on global environmental problems. Indicators shown by radar and vector charts that are visually understandable even for the public.

Earlier and on-going projects developed diverse indicators. Some of them are only applicable for the European region. However, this project developed the indicators that can be used for the Asia and Pacific region.

The information system formulated through this project be used as one of important tools for mutual understanding of environmental problems and diplomatic negotiation between developed and developing countries.

(2) Problems and issues

As 3. shows, information systems of each field in the case studies were constructed by each field, because the concept of sustainable development could not be broken down in an uniformed way. Information system should be an "expert system" that are applicable to any fields from the scientific viewpoint.

Basic data of the Asia and Pacific region were collected and used for trial-error investigation in order to select indicators. Through case studies, useful data have been collected into a chronological database system. On the other hand, data that were insufficient or lack were clarified. Data, especially in terms of environmental load were poor in the Asian countries. It is also recognised necessity that further data collection is required through existing regional networks such as TEACOM, SASCOM and SARCS that consist of Asian countries. In addition, most data regarding policy response were qualitative, which was a bottleneck to select appropriate indicators. Methods needs be established to quantify such data.

Case studies in this project were limited in the fields of agriculture, water resource and forest. In order to verify applicability of the established information system and select representative indicators covering overall fields, case studies in another fields such as energy and urbanisation need be carried out.